

of the right-ascension wires which has been found to be very accurate and convenient. The eyepiece is turned through  $90^\circ$ , and each of the right-ascension wires, now become horizontal, is in turn directed to the horizontal wires of either collimator, and the corresponding readings of both circles are taken.

The values of the revolutions of the micrometer-screws have been found in a similar way with great accuracy.

Small buildings have been erected over the Collimators, which are now therefore virtually in the same room with the Transit Circle, and the consequent steadiness in the images of the collimator wires is very remarkable.

For clock corrections the catalogue of 529 stars issued by the German Astronomical Society has been used. About six of these stars are generally taken in the course of the night's work in addition to the stars near the pole which are observed for instrumental deviation. For instrumental errors, *Polaris* has been observed sixty-six times above the pole and seventy-six times below; and  $\delta$  *Ursæ Minoris* eleven times above and ten below;  $\gamma$  *Cephei* seven times above and two below; and  $\lambda$  *Ursæ Minoris* five times above and three below. *Neptune* has been observed eleven times near the opposition.

Observations for finding the errors of level and collimation, and for determining the zenith point, are made daily in observing weather. The error of collimation has been determined 189 times, the error of level 227 times, and the zenith point 236 times. All those errors have been calculated and applied to the observed transits of standard stars throughout the year. The clock corrections and rates are also calculated.

Mr. Simms has rendered the counterpoises much more sensitive by supporting the fulcrums of the levers on knife edges. He has also made some improvements in the driving-clock of the Northumberland Equatoreal, though its performance is still far from satisfactory.

Very little time could be given to extra-meridional observations, but some good observations were obtained of Encke's Comet. The meteorological observations have been made at the usual hours of nine A.M. and three P.M.

#### *Dunsink (Dublin) Observatory.*

During the past year Dr. Brünnow has completed the observations on the parallax of five stars, namely, *Groombridge* 1830, *Bradley* 3077,  $\delta$  *Pegasi*,  $\delta$  *Draconis*, and  $\alpha$  *Lyræ*, the two latter having been compared with different stars from those used in the former series. These observations have all been computed and their results are now being printed. Two new series have been commenced on the parallax of the Planetary Nebula, H. IV. 37, and on  $\delta$  *Cygni*. The meridional observations have been interrupted for the greater part of the year, as the Transit

instrument was taken down, and the Circle admitted only of a very limited use, on account of extensive alterations in the observing-room, which were required for the mounting of a large Meridian-circle, which is shortly expected.

### *Royal Observatory, Edinburgh.*

A meeting of the Board of Visitors of this Observatory was held in July, and a Report, then presented to them by the Astronomer, was afterwards printed and published in November. It contains twenty-six pages of letter-press with five plates, and sufficiently describes all details of work up to that date.

Since then, on January 17, the Astronomer writes that he is within a few pages of the end of Volume XIII. of the Edinburgh Observatory series. It is the largest volume yet issued from this establishment; it has occupied upwards of two years uninterruptedly in preparation, and contains all the more useful observations made during the interval from 1860 to 1869, with some additions to 1871.

### *Durham Observatory.*

After holding the Directorship of the Durham Observatory for more than thirty years, the Rev. Professor Chevallier has resigned that trust during the course of the past year, to the deep regret of all interested in the progress of practical astronomy and the welfare of this establishment. No successor to Mr. Chevallier has yet been appointed.

The work performed during the past year has been chiefly the extra-meridional observation of minor planets, as in previous years, preferring those more recently discovered, which have been bright enough to come within the optical means of the Equatoreal. Some trustworthy observations of Encke's Comet have also been obtained. The reductions of these are all in an advanced state, and will be communicated shortly to the *Astronomische Nachrichten*. Two abstracts of results of Equatoreal work have been published in that journal during the past year, the first communication being of Cometary, the second of Planetary Observations. The spectrum of the Aurora Borealis has been examined on several occasions, notably on November 9; but, beyond the verification of the well-known green line, with only negative results. Some success attended an attempt to measure the diameter of the first optical ring of light round the image of the star *Polaris* by its transit over the meridional wires of the Transit Circle; but the observation, though easily and satisfactorily made, and though agreeing with a similar determination made two years ago, does not agree with the diameter which theory assigns for the object-glass employed.

The regular course of meteorological observations has been continued without intermission, forming the twenty-second year of the series, and an annual meteorological summary has been compiled as usual; but it remains only in manuscript.

### *Glasgow Observatory.*

The operations at the Glasgow Observatory during the past year have not been distinguished by any deviation from the system pursued in former years. The superintendence of the electrical arrangements connected with the transmission of Greenwich mean time to the City and Port of Glasgow has recently been transferred from the Magnetic Telegraph Company to the authorities of her Majesty's Post Office, and is characterised by the same efficiency as heretofore. Prof. Grant hopes in the course of another year to bring to a close a series of star observations with the Transit Circle which for several years past have occupied the whole resources of the Observatory, and that henceforward he will be enabled to devote more attention to observations out of the meridian. A few observations of the Comets of Encke and Tempel have been obtained with the Ochtertyre equatoreal.

### *Liverpool Observatory.*

#### *Bidston, Birkenhead.*

The work at this Observatory during the past year has been chiefly confined to the communication of time to the Port, the testing of nautical instruments, and to meteorological observations.

The firing of a gun at 1<sup>h</sup> P.M. daily is more highly appreciated than any other method of communicating time that has been adopted at Liverpool; the flash of the gun is well seen from the river and docks, and the sound is well heard in the towns of Liverpool and Birkenhead.

During the past year between three and four hundred chronometers have been tested. There appears to be wanting for the Mercantile Marine some standard of authority to appeal to for those who are interested in the performance of chronometers, in order to judge if their own instruments are of average goodness as regards regularity of performance and thermal adjustment. It is hoped that the method of exhibiting the rates of these instruments now in use at the Liverpool Observatory may to some extent be found to supply this deficiency.

The certificates of test supplied to the owners of the instruments which are sent to this Observatory show the daily rates for five consecutive weeks.

The temperature is changed  $15^{\circ}$  at the end of each week throughout the year, and all the chronometers at the Observatory

are subjected to the definite temperatures of  $55^{\circ}$ ,  $70^{\circ}$ , and  $85^{\circ}$  of Fahrenheit in succession.

In Mr. Hartnup's report to the Mersey Docks and Harbour Board for the year 1870, it will be seen that, for 381 chronometers tested in this way, the mean of all the greatest differences of daily rate between any two weeks is  $2^{\text{s}}.14$  and that  $1^{\text{s}}.61$ , or about three-fourths, of this appears to be due to error in thermal adjustment.

In order to render the information thus obtained available for comparison the rotation number, showing the order in which the instrument was received at the Observatory, has been supplied with each certificate of test. At the end of each year an abstract of the rate of each chronometer with its rotation number is published so that by preserving this number the owner of any chronometer tested at the Observatory may, by means of the printed abstracts, compare its performance with that of any other instrument, or with the average of all tested during the year, and may immediately see whether the regularity of performance was better or worse than the average.

The Liverpool Observatory was not originally supplied with self-registering meteorological instruments, but their erection was subsequently urged upon the authorities of Liverpool by merchants and scientific gentlemen resident in the town and neighbourhood. Applications are frequently made for extracts from meteorological records months and even years subsequent to the date on which the various phenomena have been recorded, and a table of results for the year 1870, which is intended to supply the information generally applied for, has been published in the Report for that year.

The testing of nautical instruments, and the taking and reducing of meteorological observations, have so much occupied the time of Mr. Hartnup during the past two years, that with but one assistant he has been able to do but very little work with the equatoreal.

### *Stonyhurst Observatory.*

The chief improvement since last year is the adaptation of a photographic apparatus to the Equatoreal, with the view of obtaining enlarged pictures of sun-spots. Images of various sizes were photographed during the summer months, and the scale finally adopted was that of  $17\frac{1}{2}$  inches to the solar diameter. Mr. Pateson, the photographer of the Preston Town Council, most kindly aided in making the necessary arrangements. The end proposed is to procure a series of photographic records of the daily, or even more rapid, changes in any remarkable spot, or group of spots.

Connected with the magnetic department of this observatory a survey of Belgium was undertaken during the months of August and September. The magnetic declination, dip, and